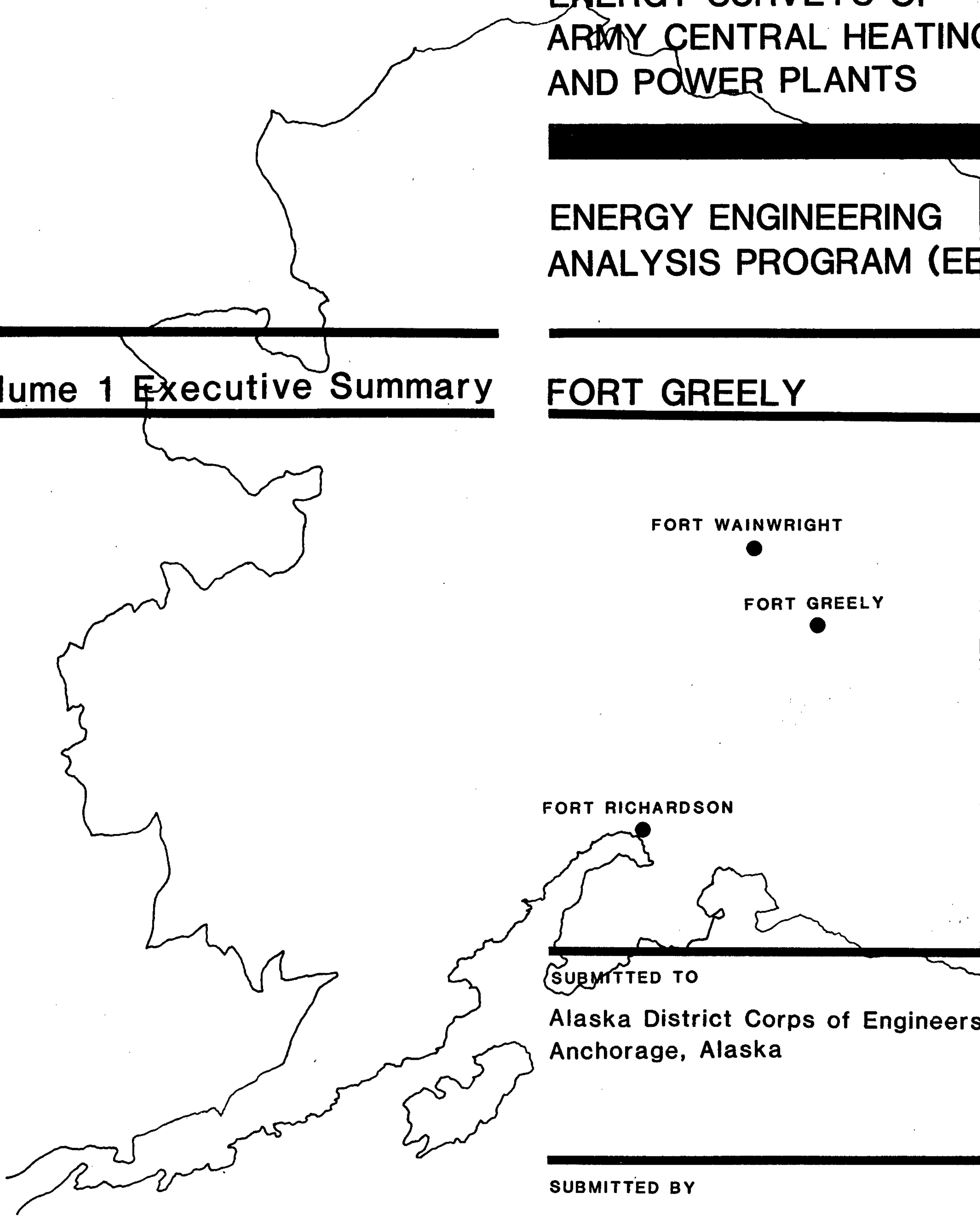
ENERGY SURVEYS OF ARMY CENTRAL HEATING AND POWER PLANTS

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

Volume 1 Executive Summary

FORT GREELY



SUBMITTED TO

Alaska District Corps of Engineers
Anchorage, Alaska

SUBMITTED BY

John Graham Company
Seattle, Washington

Schmidt Associates, Inc.
Cleveland, Ohio

April 1986

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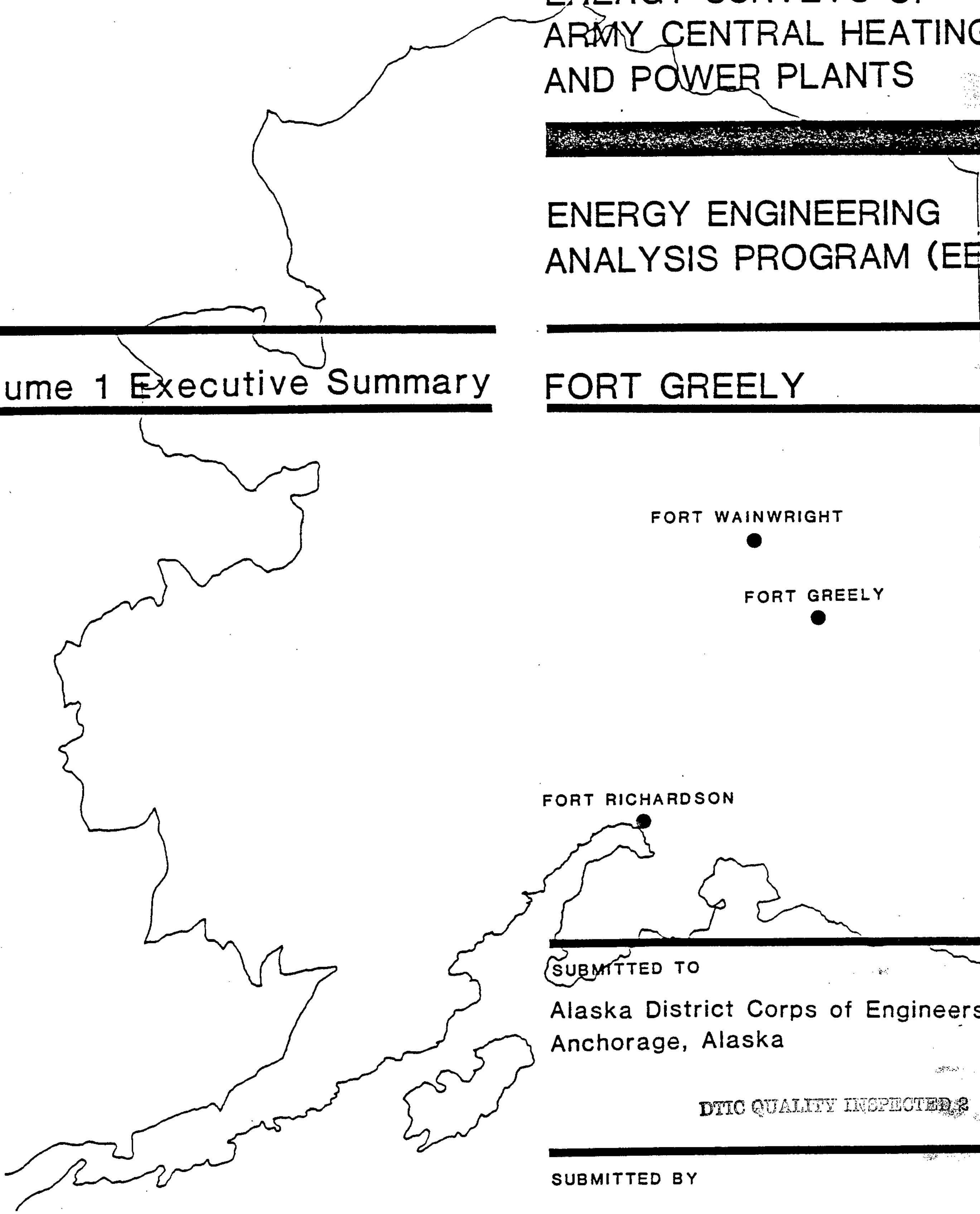

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PREFACE

This is a report of the Energy Surveys of Army Central Heating and Power Plant provided under the Energy Engineering Analysis Program (EEAP) for Fort Richardson, Fort Greely and Fort Wainwright, Alaska. This study consists of four volumes for each installation. The four volumes are completely separate reports. Volume 1, Executive Summary, briefs the report summarizing the conclusions and recommendations. Volume 2, Report, includes the executive summary and contains a description of the plants and processes. It also has a narrative discussion and evaluation of the ECOs studied at each power plant with a summary of the economics and recommendations. At the end of this volume is an outline for the operations and maintenance briefing to be provided for each installation. Volume 3, Documentation, contains the funding request documentation forms for the energy conservation opportunities (ECOs) that qualified, and other ECOs that were considered necessary for the continued operation of the central heating and power plants. Volume 4, Appendix, contains the detailed calculations, reference material and other data supporting the report and documentation.

Depending on the project cost and economics, for each viable ECO, documentation for one of the following fund programs were used:

Energy Conservation Investment Program (ECIP), 1391

Productivity Capital Investment Programs (PECIP and QRIP)

EXECUTIVE SUMMARY

FORT GREELY

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EXECUTIVE SUMMARY

FORT GREELY

SECTION 1

INTRODUCTION

1.1 Authorization

This is the Executive Summary of the energy survey and project documentation that resulted from the Energy Survey of the Central Heating and Power Plant at Fort Greely. It is a part of the continuing effort under the Energy Engineering Analysis Program (EEAP). Similar energy surveys and reports have been developed for Fort Richardson and Fort Wainwright Central Heating and Power Plants concurrently. The Scope of Work of this program was developed by the Huntsville Division Corps of Engineers for use at all Army central heating and power plants.

Representatives from the Huntsville Division of the Corps, U.S. Army Forces Command (FORSCOM) and John Graham Company, Architect-Engineer visited the Fort Greely power plant during the summer of 1984. At that time, a generic Scope of Work was reviewed. From it, a detailed scope was developed for Fort Greely. A complete Scope of Work can be found in Appendix H Volume 4 of this report.

1.2 Purpose of Study

The purpose of this study is to review and study all potential energy conservation opportunities (ECOs) at the Fort Greely Central Heating and Power Plant (CHPP). These ECOs would then be developed to determine the economics and feasibility of implementation. The equipment at this plant is over 30 years old. The plant is meeting the requirements of providing steam for heating the base. It is a functional operating CHPP plant that will, with proper maintenance and repairs, continue to perform for many more years. With a heating plant of this age there was reason to believe that many energy conservation opportunities do

exist. Section 4 describes the ECOs found and studied.

The study also required that the condition and efficiency of the boilers and auxiliaries of the entire plant be evaluated. This was necessary to establish that the plant had the ability to operate efficiently for an expected life that justified the implementation of the recommended improvements. An evaluation was made to compare the existing plant with improvements against the cost and economics of a new replacement plant. The study evaluated and found the best method of providing central heat and power for the future of Fort Greely.

A previous study by Black and Veatch, Consulting Engineers in 1978 was reviewed. Items that they recommended were included as ECOs for study in this report.

1.3 Documentation

At meetings with DEH the studied ECOs were selected for grouping into projects for documentation to accomplish the energy savings. Volume 2 evaluated each energy conservation opportunity (ECO) found at the Central Heating and Power Plant, and at the North Fort heating plant. The evaluation of the ECOs is discussed in Section 4 of this summary. The ECOs were then reviewed and developed into groups for funding requests. The funding requests are discussed in Section 5 of this summary. Volume 3 contains the documentation for the actual funding requests, for two Energy Conservation Investment Programs (ECIPs), one Military Construction Army Project Data (DD Form 1391), and one Productivity Capital Investment Program (PECIP) for funding.

1.4 Energy Survey Contract

The Energy Survey contract was awarded to John Graham Company, Engineers and Architects, of Seattle and Anchorage. Charles Schmidt, Inc., Consulting Engineers of Cleveland, Ohio worked as sub-consultants to them. Bailey Controls Company was used to calibrate instruments prior to boiler testing.

R-1

SECTION 2

2.0 Boiler Plant Description

2.1 General

The Fort Greely Central Heating and Power Plant contains three power boilers, five large diesel generators and a decommissioned nuclear reactor. Presently electric power for the installation is generated at Fort Wainwright and wheeled to Fort Greely through the utility company. The diesel generators are used only for shaving peak demand and emergencies. This study is concerned with the three power boilers at the Central Heating Power Plant and the two heating boilers in the North Fort area.

2.2 Boilers

The Central Heating and Power Plant, built in 1952, contains three Erie City Iron Works type I.W.T., two drum water tube boilers with a design capacity of 50,000 PPH, at 125 psig. The boilers have water cooled tubes and tile walls and ceiling. The boiler tubes and drums are in good condition. The casing, tile, insulation and metal skin is in poor condition. The boilers are presently being operated at 100 psig.

2.3 Burners

Each boiler is equipped with The Engineering Corporation burners. Burners are single register type. The present burner windbox and control system was installed in 1980 replacing a three register burner system. The new system with the single burner produces a long flame that impinges on the boiler tubes at high loads. Recommendations for correcting the flame impingement are contained in the report.

2.4 Controls

The 1980 modernization provided new burner controls with Bristol Babcock components. The control system is a parallel positioning type, with separate air dampers and fuel oil valve operators. There is oxygen trim with carbon monoxide tieback into the control system. The

feedwater control, furnace draft control and other components were installed new in 1980. This control system is modern and adequate for these boilers.

2.5 Fans

The forced draft fan was installed as part of the new burner front in 1980. This fan has inlet vane control that is adequate.

In 1980 variable speed controllers were added to the induced draft fans. At the same time the steam turbine drives (part of a dual drive system) were removed from boilers numbers 1 and 2 induced draft fans, leaving them with undersize electric motors. As a result, these boilers cannot operate above 30,000 PPH.

2.6 Feed Water System

The boiler plant has three full capacity motor driven feedwater pumps. These pumps draw from an elevated deaerator that is adequate in design and has ample storage capacity. The boiler blowdown goes to a blowdown tank that does not recover blowdown heat.

2.7 Plant Capacity

During most of the year only one boiler is required to maintain the steam supply. In winter, neither boilers nos. 1 or 2 can carry the load along, so two boilers must be operated.

During the year, between March 1984 and February 1985, these boilers use 1,997,669 gallons of arctic diesel oil that costs $0.95 per gallons to produce 216,545,220 pounds of steam.

2.8 North Fort Heating Plant

The North Fort heating plant heats a hanger and other buildings. This plant has two new Cleaver Brooks (200 HP) boilers generating at 60 psig. These boilers are in good condition. They are over-sized for the existing load but expansion is expected in this area. From March 1984 to February 1985, these boilers burned 92,764 gallons of arctic diesel oil to produce

9,824,872 pounds of steam. These boilers are shut down from May to September.

SECTION 3

3.0 Field Audit Work

3.1 General

A field audit team of three engineers spent four days at Fort Greely studying the Central Heating and Power Plant and the North Fort heating plant. At times, all three engineers plus plant personnel were required to perform boiler tests. At other times each engineer pursued different phases of the field audit. A week ahead of the field audit a Bailey Controls serviceman calibrated the steam flow meters.

3.2 Boiler Performance Testing

The Scope of Work required that the boilers be tested by INPUT-OUTPUT METHOD abbreviated form, in accordance with the ASME Power Test Code 4.1. The tests were run in the field to comply with both the INPUT-OUTPUT METHOD and the HEAT LOSS METHOD. In addition, the data was also collected for analysis on the Schmidt Fuel Curve which was developed by Charles Schmidt. This fuel curve and its use is described in the report. With three methods of determining boiler efficiency, a cross check was possible to compare results.

The three boilers were tested on three successive days. The tests were to be for two hours at full, 2/3 and 1/3 of maximum boiler capacity. Once the boiler had stabilized at a test condition, data was collected at 10 minute intervals until three or more consistent readings were obtained. The flue gas analyzer used was a Teledyne Analytical Instrument Model 980, portable flue gas type. This instrument measured oxygen, combustibles and carbon monoxide in the flue gas.

The temperature indicator was a Doric Scientific Series 400A Digital Trandicator with a battery powerpack. The temperature sensors are a type J, iron Constantan thermocouples, accurate to +/- one degree F. This instrument was used to measure flue gas and combustion air temperatures.

During the testing the quality of the steam in the steam drum was measured. This was done using a steam calorimeter. This determines the moisture or quality of the steam. Boiler steam drums are designed to provide steam with a minimum amount of moisture by use of moisture separators. High moisture in steam indicates failure of the moisture separators or poor boiler water treatment. The steam produced by these boilers was low in moisture indicating good conditions in the drums.

3.2 Fuel Oil

Fuel oil for the boilers is Arctic Diesel Oil. The heating value of the oil is 134,510 BTU/gallon or 19,698 BTU/LB. Data on the oil was confirmed with data from the refinery.

3.3 Efficiency Test, Boiler No. 1

Boiler No. 1 was tested at two steam load conditions as shown below. The third or high load test could not be run because the induced draft fan was unable to remove the flue gases above 30,000 PPH steam. The manufacturer's rating of this boiler is 50,000 PPH steam flow.

Test No.	1	2
Steam flow PPH	8160	23550
Boiler Efficiency		
ASME Heat Loss %	75.7%	80.8%
ASME Input-Output %	68.7%	79.1%
Schmidt Fuel Curve %	75.7%	80.7%

3.4 Efficiency Test Boiler No. 2

Boiler No. 2 was tested at the three load conditions as required and then given two special tests after the controls were adjusted to improve efficiency. These S-1 and S-2 (Special runs) show the potential improvements with better training and control adjustments.

Test No.	3	2	S-2	1	S-1
Steam Flow PPH	8900	18050	19000	26900	29050
Boiler Efficiency					
ASME Heat Loss %	79.7%	82.5%	-	80.4%	-
ASME Input-Output %	87.0%	84.3%	-	78.7%	-
Schmidt Fuel Curve %	78.6%	81.7%	83.6%	79.5%	82.7%

3.5 Efficiency Test Boiler No. 3

Boiler No. 3 was tested at three load conditions as shown below. The induced draft fan on this boiler had a 40 HP motor which was adequate for flue gas removal up to full boiler capacity. Boilers Nos. 1 and 2 have 25 HP motors on the induced draft fans. At the highest load test on Boiler No. 3 the output exceeded the base steam demand. To permit the high boiler output a steam vent was installed in a steam distribution system manhole about 500 feet from the power plant. Test results were as follows:

Test No.	3	2	1
Steam Flow, PPH	10373	28830	43350
Boiler Efficiency			
ASME Heat Loss %	79.4%	80.9%	76.7%
ASME Input-Output %	87.6%	86.2%	89.8%
Schmidt Fuel Curve %	79.1%	80.6%	76.4%

3.6 Boiler Controls

The boiler combustion controls were observed during the boiler tests. These controls were new in 1980 and proved to be adequate. After a boiler had been tested for efficiency, it was held at that load while controls were adjusted from the normal operating settings. The test instruments then showed the effect of control setting changes. This was done by the operators so that they learned the effect of these control changes.

3.7 Boiler Air Leakage

The Scope of Work required that the effect of air leakage into the boiler be studied. Air leakage results in excess air in the furnace over that which is required for combustion, which must be heated. It becomes hot flue gas that carries heat away without having produced heat. Excess air reduces boiler efficiency.

The boilers have been expanding from 75 degrees F to 2500 degrees F every time that they are started. This expansion and contraction creates cracks and openings that cause air leakage. During the field audit one boiler was shut down and allowed to cool. This furnace and tube areas of the boiler were entered and

inspected. Cracks in the tile and refractory were inspected and photographed. After the internal investigation, the boiler was sealed by closing the outlet damper manually, and smoke bombs were then ignited in the furnace. When the furnace was full of smoke the forced draft fan was turned on to pressurize the boiler forcing the smoke out cracks in the boiler casing. This was a very direct way of finding the location of boiler air leaks, and to show that the casings were in need of repair. A study of the air leakage impact on efficiency shows that repairs would provide cost effective savings.

3.8 Boiler Tubes and Drums

The water wall tubes on all three boilers are in excellent condition. The tubes are straight and free of blisters. Selected tubes in each of the boilers were tested for thickness with an ultrasonic thickness tester. Tube thickness averaged 0.104" for Boiler No. 1, 0.110" for Boiler No. 2 and 0.106" for boiler No. 3 with the original tube minimum wall thickness specified to be 0.105".

During this inspection, it was found that there was major flame impingement on the bridgewall tubes. This flame impingement was the result of the new burner installed in 1980.

3.9 Burners

The existing burners installed in 1980 are single register burners. They replaced a three register burner front that produced a flame that was the shape of the fire box. The new burner produces a good flame that becomes longer that the fire box as the load increases and impinges on the boiler tubes. Further investigation found that a manufacturer's service engineer may be able to make adjustments to correct the flame pattern.

3.10 Induced Draft Fans

The induced draft fans on Boilers Nos. 1 and 2 are not able to handle boiler firing rates above 30,000 PPH steam flow. A search of the drawings and records revealed that these fans had orginally been dual drive, with steam turbines as a primary fan drive and part load

25 HP electric motors for light loads and start up conditions. Boiler No. 3 has a 40 HP drive on its ID fan. As part of the 1980 boiler plant revisions, the turbines were removed and the existing undersized 25 HP motors were provided with variable speed controllers. A 40 HP motor is required to drive the induced draft fan to obtain the manufacturer's rated boiler capacity.

3.11 Steam Distribution

During the field audit visit, the steam and feedwater piping within the plant was observed as the boilers were being tested. The piping systems were in good shape and free of leaks. The boiler feedwater pumps were delivering rated pressure without vibration. The deaerator was providing oxygen free water. The auxiliary systems at this plant are in good condition.

3.12 Feedwater System

Feedwater system was observed in operation. The feedwater pump curves and manufacturer's data was obtained and checked against actual operating conditions. The deaerator and blowdown system was observed and measured.

3.13 Auxiliaries

All auxiliary systems relating to the CHPP operation were checked for operating condition. This included the water treatment system, steam distribution system, diesel heat recovery boilers and room heating system.

3.14 North Fort Heating Plant

This heating plant in Building T101 was observed while the two boilers and the condensate system went through several cycles.

SECTION 4

ENERGY CONSERVATION OPPORTUNITIES

4.0 General

The primary purpose of this energy engineering analysis was to study specific energy conservation opportunities in order to recommend power plant improvements and project developments. The Scope of Work lists specific ECOs to be investigated and others were developed as a result of the field audit. These ECOs were all investigated and studied. Some were found to be maintenance and operation items and others were combined with related ECOs. The ECO list included items proposed by Black and Veatch, Consulting Engineers in their 1978 study, but not implemented to date.

Energy savings were developed using best available data. Plant data and meter readings were used when available. The boiler test data became part of the energy use calculation. Costs were developed from "Means Cost Data Book" and other sources. Labor costs were escalated for Fort Greely using a 2.70 area cost factor index.

The specific ECOs studied are reviewed in this section. They are also listed on summary sheets in Section 6.

4.1 Feedwater Treatment (ECO 7.4.1)

The feedwater treatment system has been well maintained and is in good condition. The addition of some dealkalizers to this plant would reduce levels of bicarbonate alkalinity which would reduce the carbon dioxide content in the steam. This would reduce the requirements for condensate return line corrosion treatment.

The power plant has located the equipment and it is now installed. This ECO has been implemented.

4.2 Combustion Air from Ceiling (ECO 7.4.2)

The present forced draft fan is mounted on the windbox in front of the boiler. From this point it draws in 80 degrees F air while the air ten feet above is at 87.5 degrees F. By extending a duct up from the fan to use this warmer air, 3,167 gallons of oil can be saved at a cost of $3,008. This results in a payback of 2.9 years and a savings investment ratio (SIR) of 6.3.

4.3 Ceiling Air to Heat Ventilating Air (ECO 7.4.3)

In all boiler rooms heat from boilers and equipment gathers at the ceiling. Energy can be saved by using this air to heat the operating level. The investigation of this ECO found that the equipment was already existing to draw air from the ceiling and direct it into the space. This equipment needed maintenance and repair. AN ECO did not exist.

4.4 Stack Heat Exchangers (ECO 7.4.4)

The combustion gases leaving a boiler are frequently above 400 degrees F. At half load the stack gas was measured at 438 degrees F. This heat can be recovered and used. A heat exchanger in the stack at the outlet of the induced draft fans could recover this heat by heating feedwater going to the boiler.

This heat exchanger would increase resistance and add a load to the ID fan. Boiler No. 3 with a 40 HP ID fan has adequate capacity. Boilers No. 1 and No. 2 would have to re-motor the ID fans with 40 HP motors.

The arrangement proposed would increase boiler efficiency 1.35% for a savings of 81,900 gallons of fuel oil or $77,810 per year. The cost would be $641,000 for three boilers. This results in an 8.2 year payback and a SIR of 2.2.

A similar heat recovery system was recommended by Black and Veatch in 1978. They estimated a $37, 180 savings at a cost of $428,000 for a 11.5 year payback.

4.5 Operations and Maintenance Procedures (ECO 7.4.3)

This ECO reviewed operation and maintenance (O&M) procedures to determine if energy savings were possible. Many possible energy savings measures were found but all were covered by other ECOs included in this study so this section did not result in a separate ECO. O&M items covered in ECOs in this study include boiler controls, air leaks, flame impingement, heating system, summer boiler, and soot problems in the North Fort boilers.

4.6 Economizer/Air Preheater (ECO 7.4.6)

The recovery of heat from the hot gases being exhausted up the stack can be accomplished by the use of economizers in the exhaust stream. These economizers may transfer heat to feed-water or other water requiring heat, or they may transfer heat to preheat the combustion air. An example of feedwater preheating and of air preheaters is Fort Richardson CHPP.

Water type economizers are discussed in 4.4 Stack Heat Exchangers earlier. This ECO is to study the use of air preheaters in the Fort Greely CHPP. Air preheaters are large and must handle a large volume of flue gas and combustion air. This existing plant did not have space for the economic installation of an air preheater. AN ECO could not be developed.

4.7 Variable Speed Circulation Pumps (ECO 7.4.7)

The only major circulation pumps in the Fort Greely Central Heating and Power Plant (CHPP) are the three 30 HP boiler feedwater pumps. These two-stage 3545 RPM pumps have a capacity 150 GPM at 380 feet head, however, the boiler pressure has been lowered so that this pressure is no longer required during normal operation . Each pump has more than enough capacity to provide feedwater for one boiler operating at the design load of 50,000 PPH steam flow.

The flow from these pumps is now controlled by the throttling of the boiler feed valve, which wastes energy. The excess pressure drop on the feed valve causes wear and reduces the ability to provide smooth boiler level control. A variable speed controller would operate the pump at the minimum speed to provide the required feedwater pressure. This would result

in energy savings and reduced wear on pumps and control valves.

The energy savings available from variable speed drives has been known for a long time but the equipment to provide variable speed control was expensive and inefficient. During the last decade developments in the computer and semiconductor industry have reduced the cost of variable frequency motor speed control devices, which are now being generally accepted for industrial and commercial variable speed motor drives.

The energy savings have been calculated by using the average boiler feedwater flow for each month, plotted on a pump curve. The savings is estimated to be 51,922 KW/YR. or $7,041/Year. The cost of installing a variable speed controller for the circulation pump is estimated to be $26,000, providing a 3.7 year payback and a SIR of 3.2.

The installation of a variable speed controller on one boiler feed pump is recommended.

4.8 Steam Pressure Reduction (T101) (ECO 7.4.8)

The North Fort Heating Plant in Building T101 contains two Cleaver Brooks Model CB 100-200 boilers with an input of 8,369,000 BTU/Hour, generating steam at 100 PSIG. Pressure reducing valves in the plant reduce the steam distribution pressure to 60 PSIG, This ECO is to study the possibility of lowering the steam distribution pressure.

The power plant operators have lowered the steam distribution pressure by trial to the present 60 PSIG. This is the lowest pressure that will heat all the buildings. These boilers and the distribution systems are shut down during the summer, and seasonal adjustments of the pressure on this old 1948 system are not recommended. Pressure changes would cause added stress and leaks. Further reduction of the steam pressure is not recommended.

4.9 Blowdown Control T101 (ECO 7.4.9)

The North Fort Heating Plant with the two Cleaver Brooks boilers have model BAR-25 Sentry blowdown heat exchangers. These units are well

designed and capable of efficient heat recovery. The makeup water flow through the heat exchanger is intermittent with an estimate of flow occurring only 20% of the time. Modifications to increase the percentage of time flow occurs to 50% are simple. They are estimated to cost of $1,610. This increase in flow time or heat recovery time would save $584 of oil a year. This provides a payback of 2.8 years and a SIR of 6.7.

This modification to the feedwater system is recommended.

4.10 Blowdown Control, Building 606 (ECO 7.4.10)

The Fort Greely Central Heating and Power Plant (CHPP) does not recover heat from the boiler blowdown system. The continuous and intermittent blowdown is collected in a tank where the flashed steam is wasted to atmosphere and hot condensate is drained to the sewer. Most power plants of this size would recover heat from the continuous blowdown.

The cost of adding a continuous blowdown tank to the CHPP is estimated to cost about $12,000; this tank would capture 10 PSIG steam for use in the aerator and heat makeup water in a heat exchanger. This results in an energy savings of 2.69×10^9 BTU/Year or $18,979/Year. This would result in a payback of 0.63 years for a SIR of 29.2. The addition of a blowdown tank with heat recovery is recommended.

The 1978 Black and Veatch report recommended a similar heat recovery system. Their proposed system would cost $21,000 and provide a savings of $7,046 a year for a three year payback.

4.11 Air Versus Steam Atomizing (ECO 7.4.11)

The three boilers in the Central Heating and Power Plant (CHPP) have steam atomizing oil burners. This has been the standard type of oil burners for boilers of this type for several decades. This type of burner has the flexibility of being convertible to burn heavier types of fuel oil. This type of burner uses 0.7% to 0.9% of the total boiler steam flow. This is a significant energy use.

The use of air atomizing burners has been developed for light oils. The Cleaver Brooks boilers at the North Fort Heating Plant are air atomizing. Cleaver Brooks has standardized on air atomizing burners for that type of installation. Air atomizing produces better combustion with light oil while using less energy for the compression of atomizing air.

The cost to change burners is estimated to be $93,000 for all three boilers. This would result in the savings of 19,791 gallons of fuel oil a year at a cost savings of $18,800. WHen the air atomizing cost is deducted, the net savings becomes $14,417 per year. This provides a payback of 6.5 years and a SIR of 2.9. A change to air atomization is recommended.

4.12 Prevent Air Leakage (Casing Repair) (ECO 7.4.12)

The Fort Greely boiler have furnace walls that are tube and tile construction. Behind the boiler tubes are high temperature refractory tiles and high temperature insulation all encased in metal panels. The assembly of metal panels is referred to as the casing. After years of expansion and contraction this casing is in need of repair.

Leakage in the casing permits hot gases to get behind the refractory tile destroying the insulation and warping the steel panels. Casing leakage allows air that is not part of the combustion process to enter the furnace. This excess air lower boiler efficiency. The rebuilding of the casings on all three boilers is estimate to cost $1,772,265.

The boilers with a new casing and reduced air leakage will be improved in operating efficiency by 2.90% or more. This will result in an annual savings of 71,743 gallons of fuel oil a year at a cost of $68,153. per year. This results in a 26-year payback with an SIR of 0.81. The 1978 Black & Veatch report recommended further study of casing and windbox leakage, but they did not develop cost or economics. The repair of the casings is recommended to prolong boiler life and to obtain energy savings.

4.13 Variable Speed Forced Draft Fans (ECO 7.4.13)

The three boilers at the central heating and power plant (CHPP) have forced draft fans mounted over the burner windbox assembly. These 25 HP fans have inlet vane control. The efficiency of the system would be improved with variable speed control. The variable speed drive will save 152 M BTU/year for a savings of $6,000 per year. At a cost of $78,000 - this will provide a 12.86 year payback and an SIR of 1.06.

This ECO while marginal is recommended for funding. It will save energy and improve performance.

4.14 Instruments and Controls (ECO 7.4.14)

The three boilers at the Central Heating and Power Plant (CHPP) were improved in 1980 with new burners and controls. These are modern controls that are adequate for the CHPP. With normal maintenance and adjustment these controls are all that are required for efficient operation. An ECO does not exist.

4.15 Induced Draft Fan Sizing (ECO 7.4.15)

The induced draft fans for boilers NO. 1 and No. 2 with 25 HP motors are unable to remove flue gases to maintain a negative condition in the furnace area. This has limited these boilers to less than 30,000 PPH steam flow. Boiler No. 3 with a 40 HP motor is able to perform adequately with the boiler operating up to the design maximum capacity of 50,000 PPH steam flow. This ECO was to find the cause of this inadequate capacity and determine methods of correction.

In 1980 the boiler plant was renovated. The steam turbine drives were removed from induced draft fans No. 1 and No. 2 leaving them with 25 HP motors. All three induced draft fans were provided with variable speed drives. The variable speed drive has been observed and it is functioning properly. Fan load calculations confirmed by manufacturer's data in the CHPP file showed that the fan load is 32.5 BHP at full boiler capacity. A 40 HP motor and speed controller is required on ID fans No. 1 and No.

2 in order to be able to obtain full capacity from these boilers.

The replacement of these two fan drives will cost $30,500. This will not result in an energy savings. It will allow boilers No. 1 and No. 2 to obtain the designed capacity. It will allow ECO 4 described earlier to be implemented.

4.16 Evaluate a Summer Boiler (ECO 7.4.16)

The load on a Central Heating and Power Plant (CHPP) is less in summer. If the summer load is sufficiently low the CHPP operates in an inefficient range. Then a small or summer boiler that will be operating at an efficient load can be energy effective.

At Fort Greely the load only drops to 12,000 PPH in summer. This is 24% of the full load capacity of the existing CHPP boilers so the savings are not too great. A summer boiler would cost about $394,800. It would operate at higher efficiency at the lower plant loads to provide an oil savings of 6,494 gallons of oil a year at a cost of $6,169. This provides a payback of 64 years and an SIR of 0.22. A summer boiler is not recommended.

4.17 Evaluate Burner Adjustment, Building 606 (ECO 7.4.17)

The burner fronts on the boilers in the CHPP have the capability of providing fuel combustion for up to 50,000 PPH steam flow. These burners produce a long flame that starts impingement on the boiler tubes at loads above 15,000 PPH. This flames impingement reduces combustion efficiency and can damage boiler tubes.

Inspection of the oil burners revealed that an adjustment could be made to change flame shape. It is recommended that these burners be adjusted by a factory service engineer.

4.18 Evaluate Soot Problem in Building T-101 ECO 7.4.18)

The two Cleaver Brooks boilers in the North Fort heating plant, building T-101 have a soot problem after operating for long periods at low

loads. These boilers are oversized for the present load on the heating system. Soot is normal on these boiler tubes after long periods of low load operation.

The solution to the soot problem is periodic tube cleaning. The plant has been advised on how to minimize the problem.

4.19 Power Factor Correction ECO 7.4.19)

This ECO was to investigate the use of the idle decommissioned 2500 KW steam turbine generator for power factor correction. The generator is available and with minor modifications could be operated as a synchronous generator to correct power factor. The study found that Fort Greely is not charged for power factor so there is no economic basis for correcting power factor. Also, this generator is so large that the power required for bearing and windage losses would exceed any anticipated power factor savings. Power factor correction is not recommended at this time.

4.20 Previously Recommended Projects (ECO 7.4.20)

This section of the report reviews the projects recommended in 1978 by Black and Veatch. These recommendations have been incorporated into ECOs that match the recommendations. Each of the ECOs discusses the recommendations and gives the earlier cost and estimated savings.

4.21 Diesel Heat Recovery (ECO 7.4.21)

The Central Heating and Power Plant (CHPP) has three 1000 KW diesel generators that were originally equipped with exhaust gas heat recovery units. These units are not in use and need replacement. They were used to generate 10 psig steam. The diesel generators have not been used for several decades because the nuclear plant and then Golden Valley Electric provided the power required. Now the diesel generators are being operated on a regular basis so that the potential for heat recovery exists.

The installation of three diesel engine exhaust gas heat recovery units would cost $182,621. They would recover 1.142×10^9 BTU/Year. This

results in a payback of 17.7 years and an SIR of 0.94. Since the use of the diesel to generate power can not be expected to increase in the future the implementation of diesel engine heat recovery is not recommended.

4.22 Rebuilding Existing Units (ECO 7.4.22)

With the casing and several other boiler areas being recommended for rebuilding or repairs it was prudent to study the economics of a single major rebuild of the boilers. This would consolidate several ECOs along with other recommended modifications and maintenance. The effect of rebuilding would be a 2.9% increase in boiler efficiency resulting in a savings of 71,743 gallons of oil a year at a cost of $68,156 per year. This results in a payback of 35.7 years.

The economics of totally rebuilding the boilers was developed for comparison. The payback is poor; it is not recommended.

SECTION 5

DOCUMENTATION

5.1 General

The purpose of this energy engineering analysis survey was not only to find ECOs and necessary maintenance items, but to provide the documents for funding. By providing the funding documents with this study the time required to request funds and implement the improvement projects is shortened.

At the interim review conference in October 1985, the potential list of ECOs and recommended improvements and repairs was reviewed for correction and evaluation with the DEH at each installation, the Alaska District Corps of Engineers representative, the U.S. Army Forces Command representative and others. At this meeting the ECOs were selected for grouping and type of funding.

SECTION 6

SUMMARY

6.1 General

There are three summary sheets. The first summary sheet lists ECOs that are recommended energy conservation opportunities. All ECOs on this list have savings investment ratios (SIR) above one and are recommended for implementation. They all meet the requirements of the Energy Engineering Analysis Program. The second summary sheet lists those ECOs that had an SIR of less than one and could not be recommended as energy projects. Some of these ECOs are still recommended as maintenance items that are necessary for plant operation. The third summary sheet lists the ECOs as they have been grouped and documented for funding.

END OF SECTION

TABLE 1

FORT GREELY

SUMMARY OF RECOMMENDED

ENERGY CONSERVATION OPPORTUNITIES

ECO NO.	DESCRIPTION	SIR RANK	EXISTING ENERGY USAGE (MBTU/YR)	ESTIM.** ENERGY SAVINGS (MBTU/YR)	ESTIMATED SAVINGS ($000)	FY'85 CONST. COST ($000)	SIMPLE PAYBACK PERIOD (YRS)	SAVINGS INVEST. RATIO (SIR)
7.4.10	BLOWDOWN CONTROL (BLDG 606)	1	*	2687.3	19	12	0.63	29.20
7.4.9	BLOWDOWN CONTROL (BLDG T101)	2	344.26	82.65	1	2	2.76	6.67
7.4.2	COMBUSTION AIR FROM CEILING	3	268,706.0	425.92	3	9	2.91	6.32
7.4.7	VARIABLE SPEED CIRCULATING PUMPS	4	393.64	177.2	7	26	3.69	3.16
7.4.11	AIR VERSUS STEAM ATOMIZATION	5	*	2551.8	14	93	6.5	2.92
7.4.4	STACK HEAT EXCHANGERS	6	*	11,016.0	78	641	8.24	2.21
7.4.13	VARIABLE SPEED FORCED DRAFT FANS	7	248.41	152.0	6	78	12.86	1.06
7.4.21	DIESEL EXHAUST HEAT RECOVERY	8	*	1457.0	10	183	17.75	0.94

7.4.5

* NEW ITEM OF EQUIPMENT WITH NO COMPARABLE EXISTING USUAGE.
** ALL ENERGY SAVINGS ARE OIL.

TABLE 2

FORT GREELY

SUMMARY OF ENERGY CONSERVATION OPPORTUNITIES

NOT ELIGIBLE FOR ENERGY FUNDING

ECO NO.	DESCRIPTION	EXISTING ENERGY USAGE (MBTU/YR)	ESTIM.** ENERGY SAVINGS (MBTU/YR)	ESTIMATED SAVINGS ($000)	FY'85 CONST. COST ($000)	SIMPLE PAYBACK PERIOD (YRS)	SAVINGS INVEST. RATIO (SIR)
7.4.12	PREVENT AIR LEAKAGE	268,706.0	9650.2	68	1,772	26.0	0.81
7.4.16	EVALUATE SUMMER BOILER	7034.67	873.5	6	395	64.0	0.22
7.4.22	REBUILDING EXISTING UNITS	268,706.0	9650.2	68	2,435	35.73	0.59
7.4.21	DIESEL HEAT RECOVERY	*	1457.0	10	183	17.75	0.94

* NEW ITEM OF EQUIPMENT WITH NO COMPARABLE EXISTING ENERGY SAVINGS.

** ALL ENERGY SAVINGS ARE OIL.

TABLE 3

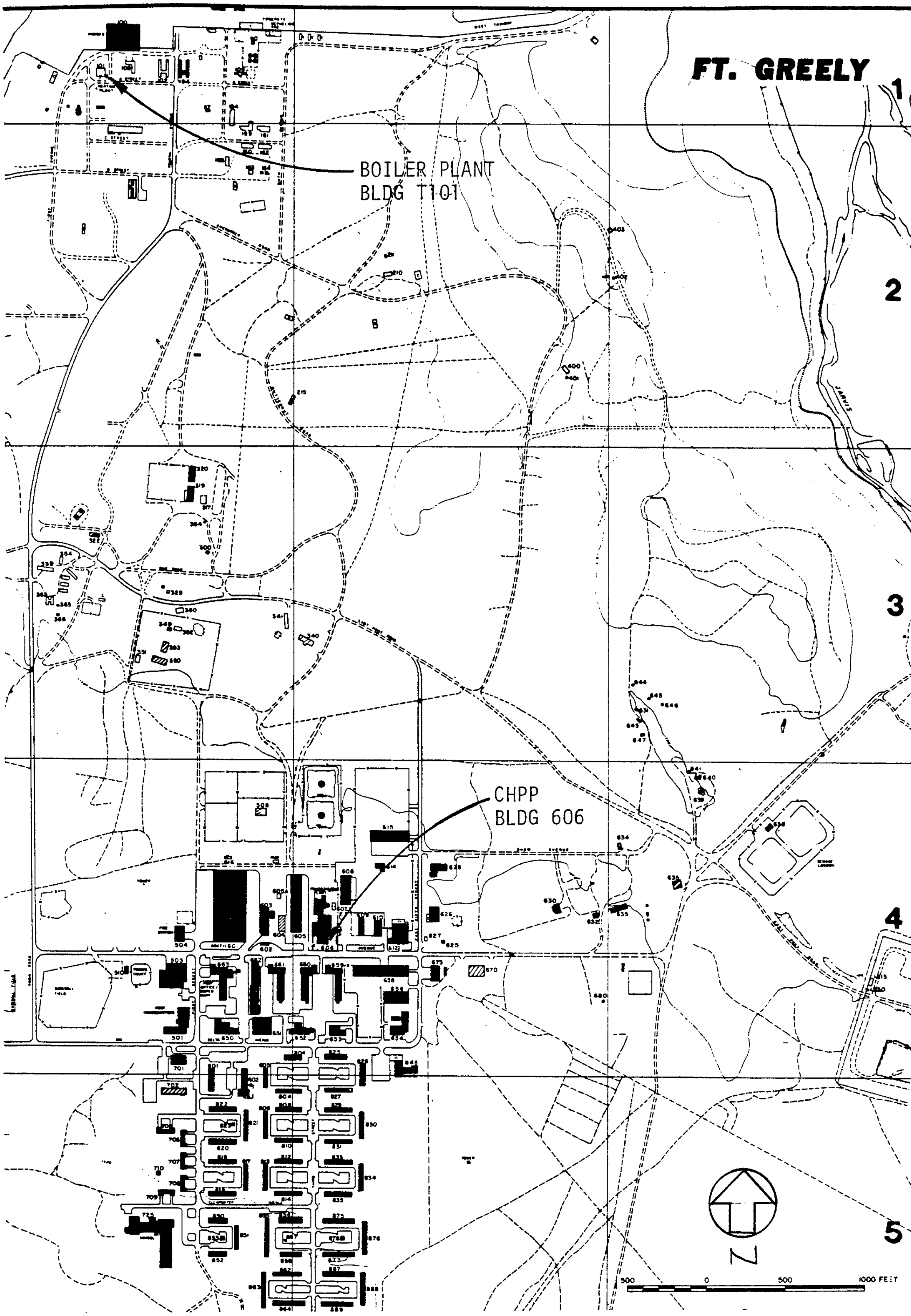
FORT GREELY

SUMMARY OF ENERGY CONSERVATION OPPORTUNITIES

DOCUMENTED FOR FUNDING

ECO NO.	DESCRIPTION	SIR RANK	EXISTING ENERGY USAGE (MBTU/YR)	ESTIM.** ENERGY SAVINGS (MBTU/YR)	ESTIMATED SAVINGS ($000)	FY'85 CONST. COST ($000)	SIMPLE PAYBACK PERIOD (YRS)	SAVINGS INVEST. RATIO (SIR)
7.4.2	COMBUSTION AIR FROM CEILING	1	*	425.92	3	9	2.91	6.32
		PECIP		WARM COMBUSTION AIR				
7.4.7	VARIABLE SPEED CIRCULATING PUMPS							
7.4.9	BLOWDOWN DONTROL (BLDG T101)							
7.4.10	BLOWDOWN CONTROL (BLDG 606)	2	*	5,651.93	47	210	4.47	3.78
		ECIP		BOILER PLANT IMPROVEMENTS				
7.4.11	AIR VERSUS STEAM ATOMIZATION							
7.4.13	VARIABLE SPEED FORCED DRAFT FANS							
7.4.4	STACK HEAT EXCHANGERS							
		3	*	11,016.0	78	672	8.63	2.13
7.4.15	INDUCED DRAFT FAN SIZING	ECIP		STACK ECONOMIZERS				
7.4.12	PREVENT AIR LEAKAGE	4	268,706	9,650.2	68	1,772	26.0	0.81
		1391		REBUILD BOILER SETTINGS				

* NEW ITEM OF EQUIPMENT WITH NO COMPARABLE EXISTING ENERGY SAVINGS.
** ALL ENERGY SAVINGS ARE OIL.



FORT GREELY SITE PLAN